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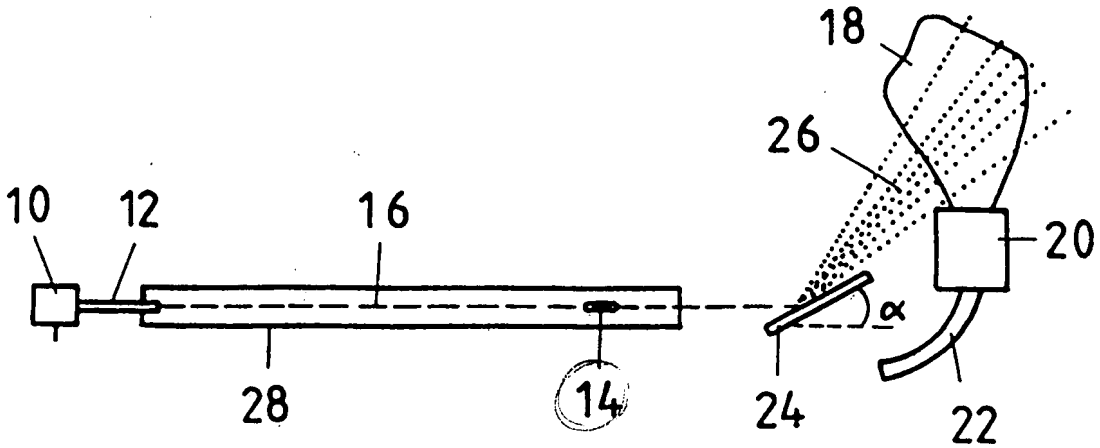
(54) Title: METHOD AND APPARATUS FOR IGNITING INFLAMMABLE GASES IN A FLARE TOWER



(57) Abstract

There is disclosed a process for the ignition of combustible gas (18), which is released in a flow of gas in a flame tower, where a priming means (14) is used to ignite the flow of gas. The priming means (14) is in the form of a projectile, which is fired in a path (16) in a direction towards the release of gas. The priming means is caused to impact against a stop plate (24) which is arranged in the release of gas, whereby the priming means (14) deforms and detonates and causes a flow of incandescent particles (26) into the gas flow (18), which is thereby ignited. The path of the projectile is protected with a pipe arranged concentrically of the path. The incandescent particles are produced by the use of a priming means (14) including particulate zirconium metal (76), which on impact and deformation of the priming means (14) against the stop means (24), is caused to burn. There is also disclosed an apparatus for carrying out the process.

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Method and apparatus for igniting inflammable gases in a flare tower.

The present invention relates to a process and an apparatus for the ignition of combustible gas which is released into a flame tower, where a priming means is used to produce an ignition temperature in the flow of gas.

The invention has to do in particular with oil/gas treatment plants, for example at sea, where gas and oil are separated into isolated fractions. The gas fraction is utilised by either being conducted on land for further employment or it can be used for the production of energy and the like at the installation itself. Normally such installations have a separate collection conduit system where excess gases are collected and led to a flame tower where the gases are burned off. When irregularities or emergency situations arise in the plant the whole or portions of the gas fraction can be burned off in the tower.

As is evident from Norwegian Patent Application No. 931596, belonging to this Applicant, a solution is provided

with which the excess gas can also be used for serviceable purposes, in that this gas is conducted together with the main production of hydrocarbon gas.

Since the whole of the extracted gas fraction is used for serviceable purposes, it will happen that the flame tower remains standing idle over longer periods, since it is only activated for burning off of gas during emergency situations when gases must be led to the flame tower and burned off.

In such a case the ignition must occur immediately. Installations also exist where the hydrocarbon gas is released into the atmosphere without being burned.

A series of devices are known which are used to ignite gases in a flame tower. Of these shall be mentioned the system with pilot burners which involves the arrangement at the gas outlet mouthpiece of one or more gas burners which burn the whole time with a small flame. When the gas begins to flow out from the main outlet, it is lit immediately. It is also known to employ electrical pulsed spark generation from a spark plug, a standing electric arc, or a filament in order to light such a flame. Furthermore it is also known to light such a flame by means of a signal pistol, with which a (pyrotechnic) ignition charge is fired towards the gas which flows out from the tower.

Several types of pyrotechnic ignition devices exist enclosed in a ampoule. Common to them is that a strong exothermic reaction is initiated which produces a high temperature so that the gas is ignited. In one type chemicals are used which react exothermally on contact with air/moisture. Examples of such substances are white phosphorus, and triethyl aluminium. In another type a powdered element, such as a metal, is used which above a given temperature oxidises/burns in contact with air. The metal is ignited by way of a priming means, or is brought to

ignition as a consequence of the development of heat which follows the heavy compression on impact against a target. Such devices are known within the defence technology for the production of incendiary grenades and the like, and are mentioned for example in U.S. patent specifications 3,720,169, 4,015,529, GB-patent specification 1,508,629, and DE-Laid-Open specification 34 01 538.

Against the background of the above it is an object of the present invention to provide a novel process and novel apparatus with which a combustible gas which flows out from the outlet in a flame tower, can be rapidly ignited and with a high degree of reliability.

Furthermore an aim is to be able to employ a priming means which is not ignited exclusively on contact with the oxygen of the air, but which requires a given compression energy and/or a suitable percussive agent in order to ignite.

The process according to the present invention is characterised in that the priming means is fired in a path in a direction towards the gas release , and is caused to impact a stop means arranged at the gas release, whereby the priming means detonates and disperses a stream of incandescent particles into the outflowing combustible gas, which is thereby ignited.

According to a specific mode of the process the incandescent particles are produced by the application of a priming means including a particulate material, preferably a metal, preferably zirconium metal, which on impact of the priming means against the stop means, is caused to burn.

Other specific modes of the process according to the invention are evident from the accompanying dependent process claims.

With this process a considerable dispersion of incandescent particles is achieved, and an accompanying large

likelihood that a sufficient number of these come into contact with the gas so that the latter is ignited. Even if the outflow pattern of the gas can vary strongly, depending on the outflow volume per unit of time and the wind conditions around the flame tower, the novel method of ignition will produce a very high lighting reliability even at the firing off of the first priming means.

The apparatus according to the present invention is characterised by a pressure fluid-driven device for firing the priming means in a path towards the gas release, a stop means situated, at the gas release, in the firing path which causes detonation (setting off) of the priming means when the latter hits the stop means, and a portion of said path including a path protective element.

It is preferred that the stop means comprises a plate-formed body which is arranged at an oblique angle α relative to the firing path of preferably 90-45°.

The path protective element preferably comprises a pipe having a larger internal cross-sectional dimension (caliber) than the priming means used. Preferably the path protective element is arranged along the flame tower and extends from the firing device and forwards to the region just in front of the stop means.

The apparatus is further adapted for firing of priming means on a signal from continuously registering instruments in the conduit which delivers gas to the torch.

In the following description the invention shall be explained further having regard to the accompanying drawings, in which:

Fig. 1 shows a schematic section of the apparatus according to the invention.

Fig. 2 shows enlarged a detail in the apparatus according to Fig. 1.

Fig. 3 shows an installation with which the apparatus according to the invention can be used.

Fig. 4 shows an enlarged vertical section through a priming means which can be used according to the invention.

In the dissimilar Figures like elements are represented by the same reference numerals.

The main parts of an apparatus 10 according to the invention are shown schematically in Fig. 1. The apparatus 10 comprises a firing device in the form of a pressure fluid-driven firing cannon having a firing pipe (a cannon barrel) 12 for firing off a priming means in the form of a projectile 14 in a firing path 16 which is illustrated in dotted line. The projectile 14 is fired off in the path 16 towards a flame tower (shown in its totality at 62 in Fig. 3) in order to ignite a combustible hydrocarbon gas 18 which flows out from an outlet mouthpiece 20 in the upper portion of the tower. The gas is led forwards to the flame tower through a conduit 22.

In the path 16 of the projectile 14 there is arranged a stop means in the form of a stop plate 24 which entails the projectile being deformed and compressed on impact against the plate. Thereby a portion of the kinetic energy of the projectile is converted to heat, so that the contents of the projectile merge/react during the development of burning/incandescent particles or sparks. The stop plate 24 is preferably arranged at an oblique angle α, preferably in the region of 90-45°, relative to the firing path 16 of the projectile 14. Consequently reaction products of sparks will be deflected and outwardly dispersed as a rain of sparks, as is illustrated by dotted lines 26. The stop plate 24 is arranged so that the rain of sparks 26 is led forwards towards the outwardly flowing gas 18 and ignites the latter. The stop plate is preferably a steel plate, and preferably

has a rough surface so that the projectile shall be more readily deformed on impact.

The rain 26 of sparks will thus have a dispersal and a size which will cover a large volume at/around the mouthpiece 20 and ignite the gas. Even if the course of the outward flow of gas can vary strongly, depending on the volume of gas out from the mouthpiece 20 plus the current direction of the wind, so will the gas 18 be ignited with a large degree of certainty by the rain 26 of the incandescent particles.

From the outlet of the firing pipe 12 and forwardly towards the stop plate 24 the firing path 16 is shielded against the surroundings by means of a protective element 28. The protective element 28 comprises a pipe which is arranged concentrically of the firing path 16. While the firing pipe 12 has a caliber equivalent to the projectile 14, the protective element has a somewhat larger caliber, that is to say a larger internal cross-sectional diameter than the projectile 14. The projectile 14 shall normally not contact the pipe 28 internally on its journey forward towards the stop plate 24. Under given weather conditions however it can transpire that the tower will swing about its mounting in the deck of the platform. In such an instance the projectile can come into contact and be deflected against the inner wall of the protective pipe. This will however not be a sufficient impact for the projectile to be ignited within the pipe. The said deflection will increase the certainty of a hit against the stop plate which swings together with the tower.

An important purpose of the protective pipe 28 is to prevent foreign objects, for example of maintenance workers in/along the flame tower (see Fig. 3), unintentionally coming into the firing path 16 of the projectile 14.

In Fig. 2 the firing apparatus 10 is shown in more detail. The Figure shows how the firing pipe 12 projects out

of a protective cover 30 for the apparatus, as well as the placing of the protective pipe 28.

The vital parts of the apparatus 10 are arranged internally in the cover 30, and comprise a firing off mechanism, a loading mechanism and control means for these.

The firing off mechanism includes a chamber 32 for fluid which is connected via a connection conduit 34 to a storage container 36 for pressure fluid. In the connection conduit 34 there is arranged a valve 40. Furthermore a valve 41 is arranged downstream of the loading chamber 32 in the inlet to the firing off pipe 12. In the storage container 36 the fluid is held, by means of a compressor 38, at a high pressure. As fluid preferably air is employed.

In connection with the firing pipe 12 there is arranged a magazine 42 with a number of projectiles 14. Projectiles are introduced one by one into the pipe by means of the loading mechanism. Immediately a projectile is fired, the loading mechanism conveys a new projectile 14 from the magazine 42 and into the pipe 12.

Valves 40 and 41 of the firing off mechanism as well as the loading mechanism are connected via respective conduits 44 and 46 to a control unit 48, which regulates and coordinates the admission of fluid to the fluid loading chamber 32 and the consecutive loading of projectiles 14 in the pipe 12. The unit 48 controls the firing apparatus on the basis of registrations from measuring instruments which continuously register gas flows occurring in the conduit 22 (Fig. 1), and a conduit 50 transfers the registrations to the control unit 48.

At the starting point the valve 41 is maintained closed while the valve 40 is opened so that the chamber 32 is filled with fluid until the pressure in the chamber 32 is in the region of 200-300 barg. Thereafter the valve 40 is closed.

When the control unit 48 later receives a signal about the existence of gas occurring in the conduit 22, a projectile 14 is introduced into the firing pipe 12 and the valve 41 is opened and releases the pressure fluid in a powerful pulse from the firing off chamber 32 into the pipe 12 so that the projectile 14 in the pipe 12 is thrust out at great speed.

Thereafter the valve 41 is closed, the valve 40 opens and releases a quantity of fluid into the loading chamber up to a pressure of 200-300 barg, after which the valve 40 is closed, and the loading unit conveys a new projectile 14 from the magazine 42 and into the pipe 12. With that the loading is completed again. When the firing apparatus according to the invention is activated, the afore-mentioned course of events is repeated a number of times, so that there is consecutively fired off a fixed number of projectiles towards the top of the flame tower 62. Thereby the igniting of the gas 18 is ensured.

By means of boundary edge/interface 52 the firing apparatus according to the invention is connected to the monitoring system of the platform, for example towards its closing down system. This connection serves to be able to register that the firing apparatus is intact and ready for use. Inter alia the fact that the loading apparatus and the pressure fluid system are intact will be registered, and for example that a sufficiently high fluid pressure is achieved in the fluid loading chamber 36.

Fig. 3 shows how the ignition arrangement according to the invention can be arranged on board in an installation at sea where oil is extracted and also comprises a plant where dissolved gas is separated from the oil. The installation 60 comprises a flame tower 62 where excess gases 18 are burned off.

According to the invention the firing arrangement 10 is

arranged on a deck 64 of the platform while the protective pipe 28 is permanently arranged to the flame tower 62 itself and directed towards the stop plate 24 and the release mouthpiece 20 for gas 18. Fig. 3 shows how the stop plate 24 is arranged in the flame tower just in front of the outlet mouthpiece 20 for the combustible gas.

Fig. 4 shows a projectile 14 which is used in the present invention. The projectile has the same caliber as the firing pipe 12, and comprises a jacket 70 which is of a suitable metal and which defines a space in which there is arranged in the front end 72 a primer 74. The jacket of the projectile is preferably of aluminium, but other suitable metals can also be used, such as thin plates of steel sheet, or a suitable plastic material. In the middle portion of the space a pyrotechnic mixture 76 is arranged. The rear portion of the projectile is formed by a bottom plug 78.

The fired projectile is deformed when it impacts against the stop plate 24, the primer detonates (sets off) and involves the pyro-mixture in being ignited and forming the afore-mentioned rain 26 of sparks. As a primer a plastic explosive can be used. Such a material will behave as a plastic and only burns if it is exposed to strong heat, such as on a fire beginning at the installation.

Another material having the designation RS-41 and consisting of a mixture of magnesium and aluminium powders mixed with potassium perchlorate and calcium resinate, will be particularly well suited as a primer. This material is extremely sensitive to friction, so that it will detonate easily when the projectile is deformed on impact against the plate 24.

The pyro-mixture is transformed by a strong exothermic reaction something which produces a high temperature so that the mixture merges during the formation of a large number of

incandescent particles which constitute the afore-mentioned rain of sparks. Consequently the gas is ignited.

According to an example the pyro-mixture is a powdered element, such as a metal, which is ignited by the primer and burns on contact with oxygen of the air. According to the invention it has been found that zirconium is a well-suited metal for such a mixture. The ability of the zirconium to ignite is dependent on the particle size. Thus there is reported self-ignition in air with grain sizes in the region of 5-50µm. With larger particle dimensions of the powder, which are of current interest for the present invention, a temperature of about 800°C will however be necessary in order to get the metal to incandesce with a relatively long-lasting incandescent time. By virtue of the impact against the plate the burning Zr-particles will form a rain 26 of sparks directed towards the gas 18. With normal handling, or with falls and knocks zirconium is on the other hand not dangerous. Besides it is well known within the defence technology to use zirconium for the afore-mentioned spark-formation purposes, for example for manufacturing incendiary cartridges and the like. The zirconium can besides be replaced by a series of other particulate chemicals, hence also a series of metals, which will be ignited analogously to zirconium.

In another type of pyro-mixture chemicals can be used which react exothermally on contact with air/moisture. Examples of such substances are white phosphorus, and triethyl aluminium. Of other types of pyromaterials such chemicals shall be mentioned which are stored separately in the projectile, and which react spontaneously when they come into contact with one another when the projectile 14 is deformed on colliding with the stop plate 24.

Since the firing apparatus according to the invention is

preferably used at an installation where an especially high degree of fire safety is required, it is preferred to use the afore-mentioned zirconium-containing projectile, especially since there is no danger of self-ignition if the jacket 70, as a consequence of an accident, should unintentionally give air access to the zirconium particles.

The present invention is explained where an air cannon is used as firing apparatus. However firing apparatuses of other types can also be used, for example of the type where the projectile is ejected by a spring which is tensioned for each projectile which is loaded in the barrel 12. The air cannon is however the most preferred firing apparatus in this connection.

Example

In a test on an experimental scale a projectile was used consisting of a container/jacket of an aluminium container, and this was filled with the primer RS-41 mentioned previously and a quantity of powder of zirconium metal. The primer RS-41 had an ignition temperature of 450-500°C, while the zirconium powder had an ignition temperature of 800°C. The finished projectile had a weight of about 40 grams. On firing there was used an air cannon (that is to say a firing apparatus driven by air) of the construction mentioned earlier, and a source of combustible methane gas was set up at a suitable distance from the stop plate. During the firing off experiments the extent of the gas release was varied, both in volume per unit of time, and in direction and circulation by artificially establishing a wind effect. On firing off an exit speed from the air cannon was achieved of the order of magnitude of 300-400 m/sec. By way of introduction projectiles were fired off one by one after which the igniting effect was estimated. Thereafter experiments were carried out by firing off a series of 4

projectiles in rapid succession. On impact against the stop plate the projectiles were deformed, the primer detonated and the burning of the zirconium powder initiated which by deflection from the plate formed a rain or swarm of sparks forwards towards the outwardly flowing methane gas. Even with a strongly varying circulation of methane gas from the source, it was ignited by the sparks from the projectile.

In the experiments where there were fired off continuously a set number of projectiles in succession, it was found that the gas was ignited to a predominant degree by the first projectile in the series.

This shows that in the present invention a novel arrangement is produced which in a rapid, effective and reliable manner can ignite the release of hydrocarbon gases in a flame tower.

PATENT CLAIMS

1. Process for the ignition of combustible gas (18) which is released in a flame tower (62), where a priming means (14) is used to produce a temperature sufficient in a portion of the gas flow, for the gas to be ignited, characterised in that the priming means (14) is fired in a path (16) in a direction towards the gas release, and is caused to impact against a stop means (24) arranged at the gas release whereby the priming means (14) detonates and spreads a stream of incandescent particles (26) into the outflowing combustible gas (18), which is thereby ignited.

2. Process according to claim 1, characterised in that the priming means (14) is fired by means of a pressure fluid-driven device (10), where the fluid is preferably air.

3. Process according to claim 1 or 2, characterised in that a set number of priming means are continuously fired, in order to ensure igniting of the gas (18).

4. Process according to claim 1, characterised in that the incandescent particles are produced by the use of a priming means (14) including a particulate material, such as a metal, and preferably zirconium metal (76), which on impact of the priming means (14) against the stop means (24), is caused to burn.

5. Apparatus (10) for firing a priming means (14) for the ignition of combustible gas (18) which is formed in a gas treatment plant and which is led through a conduit (12) forwards to a release in a flame tower (62), characterised b a pressure fluid-driven device (32) for firing the priming means (14) in a firing path (16) towards the gas release (18), a stop means (24) situated in the firing path (16), at the gas release (18), which brings about setting off of the priming means (14) when this hits the stop means, and a portion of said path including a path protective element (28).

6. Apparatus according to claim 5, characterised in that the stop means comprises a plate-formed body (24) which is arranged at an oblique angle α relative to the path (16), preferably at an angle α equal to 90-45°.

7. Apparatus according to claim 5 or 6, characterised in that the path protective element comprises a protective pipe (28) having a somewhat larger internal cross-sectional dimension (caliber) than the priming means (14) used.

8. Apparatus according to one of the claims 5-7, characterised in that the protective pipe (28) extends from the firing device (32,12) and forwards to the region before the stop means.

9. Apparatus in accordance with one of the preceding claims, characterised in that the path-protective element (28) is arranged along the flame tower.

10. Apparatus according to claims 5-9, characterised in that it is adapted to fire off priming means on a signal from continuously registering instruments in the conduit which delivers gas to the flame tower (62).

FIG. 1

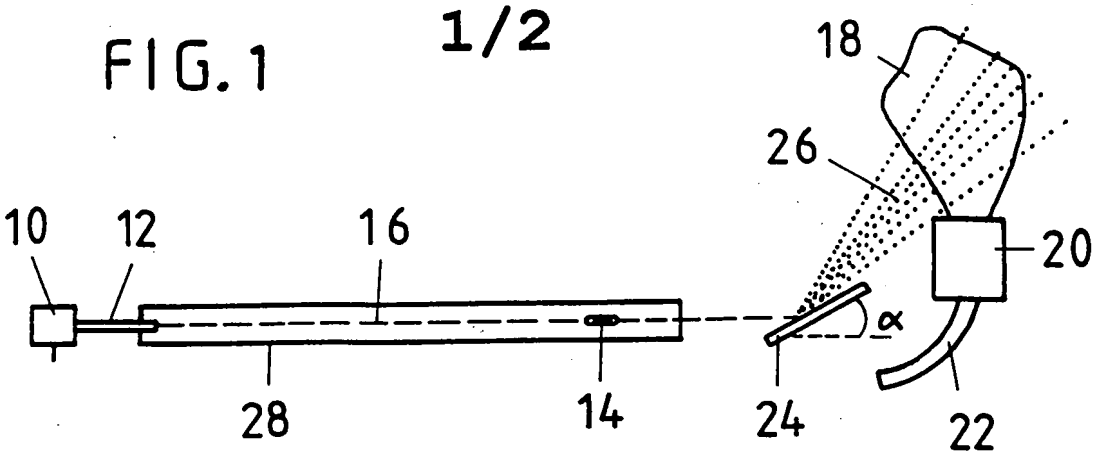
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FIG. 2

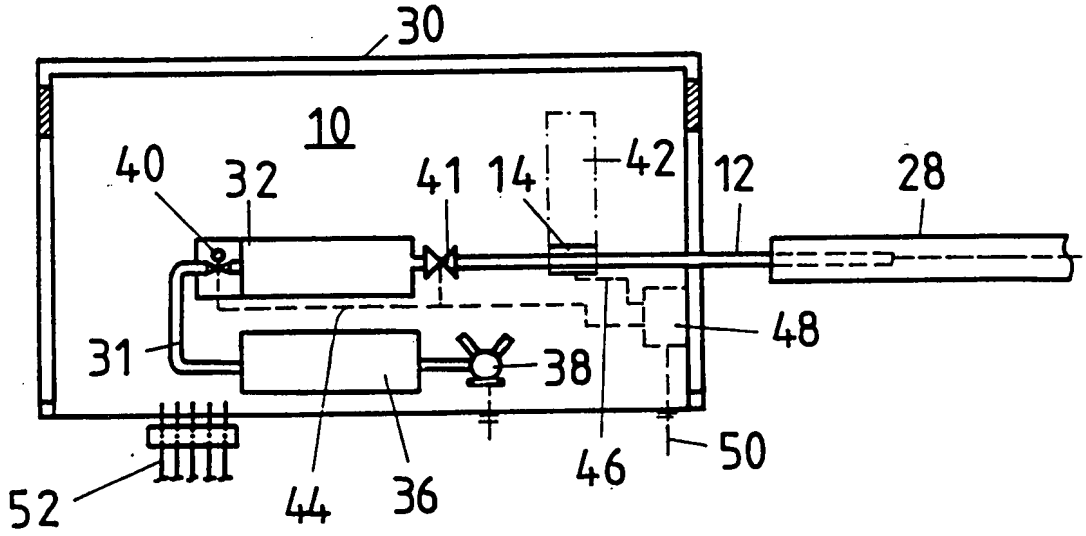
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FIG. 3

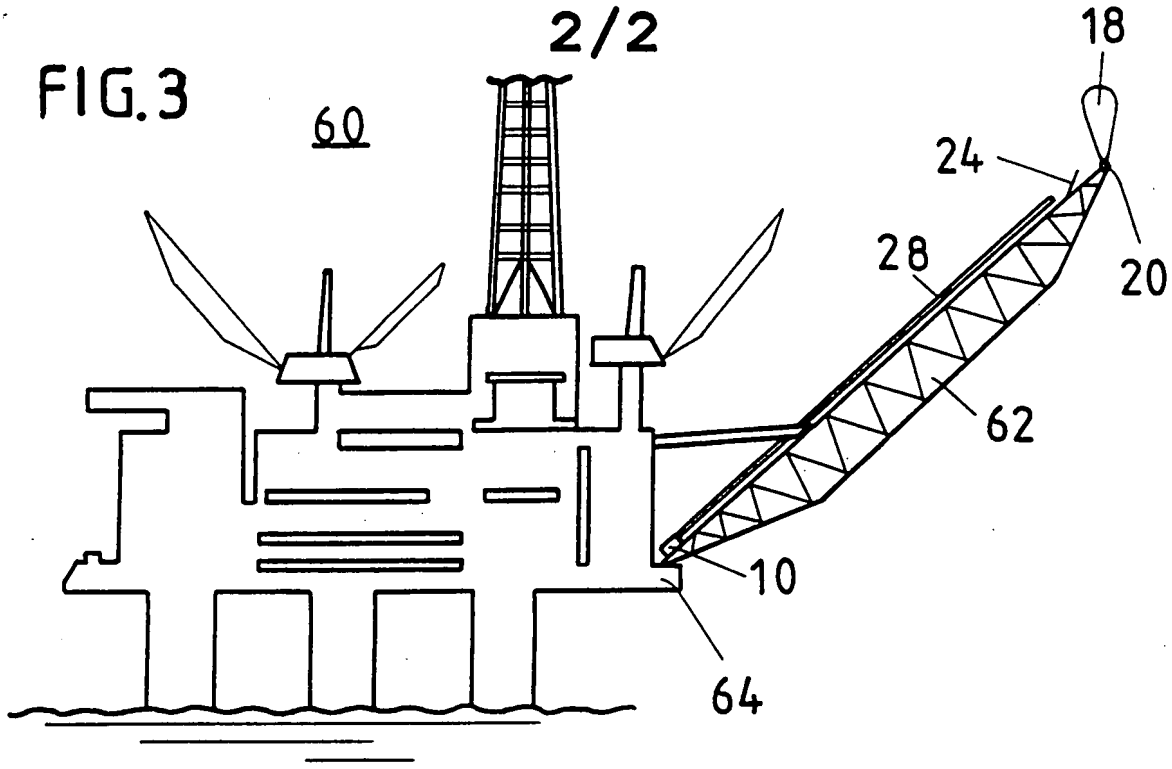
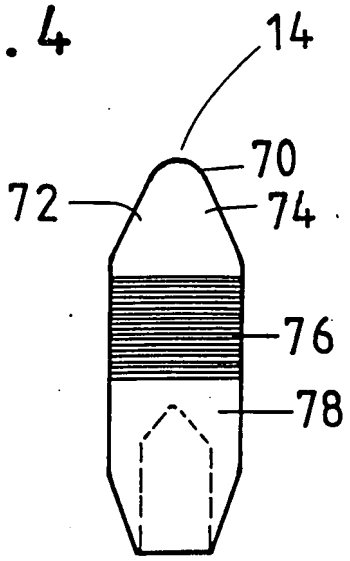


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 94/00101

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: F23Q 13/00, F23Q 21/00, F23G 7/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: F23G, F23Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPAT, USPM

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP, A2, 0069654 (ELF FRANCE), 12 January 1983 (12.01.83), figure 1, abstract --	
A	US, A, 2696875 (J.B. HENWOOD), 14 December 1954 (14.12.54), column 1, line 37 - line 43, figure 1 --	
A	US, A, 1633567 (J.L. BREESE, JR), 28 June 1927 (28.06.27), column 3, line 39 - line 45, figures 1-4 --	
A	US, A, 2830658 (W.R. SMITH), 15 April 1958 (15.04.58), column 3, line 45 - line 51, figure 1 --	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 2436305 (T.B. JOHNSON), 17 February 1948 (17.02.48), figures 1,2	

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INTERNATIONAL SEARCH REPORT
Information on patent family members

02/07/94

International application No.
PCT/NO 94/00101

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